

Claims

What is claimed is

1. A method of identifying a defect in a semiconductor wafer, the method comprising:

5 applying heat to a conductive structure formed on said semiconductor wafer;

measuring a signal indicative of temperature of a portion of the conductive structure heated by conduction of the applied heat therethrough, thereby to obtain a
10 measurement;

repeating the act of measuring at each of a number of different locations on the conductive structure, thereby to obtain a plurality of measurements; and

determining presence of the defect in the conductive
15 structure, depending on the plurality of measurements.

2. The method of Claim 1, wherein:

a laser beam is used during said applying of heat;
reflection of another laser beam is measured during
said measuring; and

20 the laser beams are scanned together during said measuring.

3. The method of Claim 2, wherein:

the laser beams are coincident, thereby to form a single spot on the conductive structure.

25 4. The method of Claim 1, wherein:

the conductive structure has at least one dimension less than 1 μm .

5. The method of Claim 1, wherein:

an electron beam is used during said applying of heat.

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6. The method of Claim 1, wherein:
a thermal imager is used during said measuring.
7. The method of Claim 1, wherein:
said conductive structure is periodic in space along a
5 direction, and said locations are along said direction.
8. The method of Claim 7, wherein:
said determining includes using a transform of said
plurality of measurements, said transform converting said
plurality of measurements from a spatial domain into a
10 frequency domain.
9. The method of Claim 7, wherein:
said determining includes identifying a frequency
component not found in a corresponding plurality of
15 measurements from a reference wafer.
10. The method of Claim 7, wherein:
said determining includes comparing a curve defined by
said plurality of measurements to a reference curve defined
20 by a corresponding plurality of measurements from a
reference wafer.
11. The method of Claim 7, wherein:
said determining includes comparing a curve defined by
25 said plurality of measurements to a baseline.
12. The method of Claim 7, wherein:
a measurement is performed at least at a plurality of
vias located sequentially one after another in said
direction.

13. The method of Claim 7, wherein:

a pump beam is incident on a first trace in the
conductive structure during said applying; and

a probe beam is incident on a second trace in said
5 conductive structure during said measuring; and

wherein said first trace is coupled to said second
trace through at least one via.

14. The method of Claim 11 wherein:

10 each of said first trace and said second trace are in a
single metal layer.

15. The method of Claim 11, wherein:

each of said first trace and said second trace are in
different metal layers.

16. The method of Claim 1, wherein:

said determining includes comparing the plurality of
measurements to a corresponding plurality of measurements
obtained from a reference wafer.

17. The method of Claim 1, wherein:

20 said repeated acts of measuring are performed while
moving a stage carrying the semiconductor wafer containing
the conductive structure; and

performing said measuring continuously, thereby to
obtain an analog signal; and

25 using said analog signal during said determining.

18. A method for determining the quality of a conductive
structure, the method comprising:

applying heat to the conductive structure using a
modulated heat source;

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measuring a phase difference between temperature change of said conductive structure and modulation of said heat source; and

analyzing said phase difference to determine quality of
5 said conductive structure.

19. The method of Claim 18 wherein reflection of a laser beam is used to measure the phase difference.

20. The method of claim 18 wherein said quality is related to a defect in said conductive structure.

21. The method of Claim 20 wherein said defect is any defect in a group consisting of voiding, narrow trace, and misalignment of a via to a trace.

22. A method for determining the quality of a conductive structure, the method comprising:

15 applying heat to the conductive structure using a modulated heat source;

varying the frequency of modulation of said heat source;

20 measuring a change in temperature of said conductive structure, as a function of the frequency of modulation; and

analyzing said function to determine the quality of said conductive structure.

23. The method of Claim 22, wherein reflection of a laser beam is used to measure the temperature change.

24. The method of Claim 22, wherein heat is applied to said conductive structure using a laser beam.

25. The method of Claim 22 further comprising:

repeating the act of measuring at each of a number of different locations on the conductive structure, thereby to obtain a plurality of measurements; and

using said plurality of measurements during said
5 analyzing.

26. The method of Claim 22 further comprising:

moving a stage carrying a semiconductor wafer containing the conductive structure at a fixed speed; and performing said act of measuring continuously, thereby
10 to obtain an analog signal; and using said analog signal during said analyzing.

27. The method of Claim 22 wherein said analyzing comprises:

identifying irregular features in the conductive
15 structure.

28. An apparatus for identifying a defect in a conductive structure, the apparatus comprising:

a laser for applying heat to the conductive structure; the sensor for measuring a signal indicative of
20 temperature of a portion of the conductive structure heated by conduction of the applied heat therethrough; and means for determining presence of the defect in the conductive structure, based on the measured temperature.

29. The apparatus of Claim 27, wherein said sensor for
25 measuring comprises a thermal imager.

30 30. The apparatus of Claim 27 wherein said means for determining comprises a personal computer.